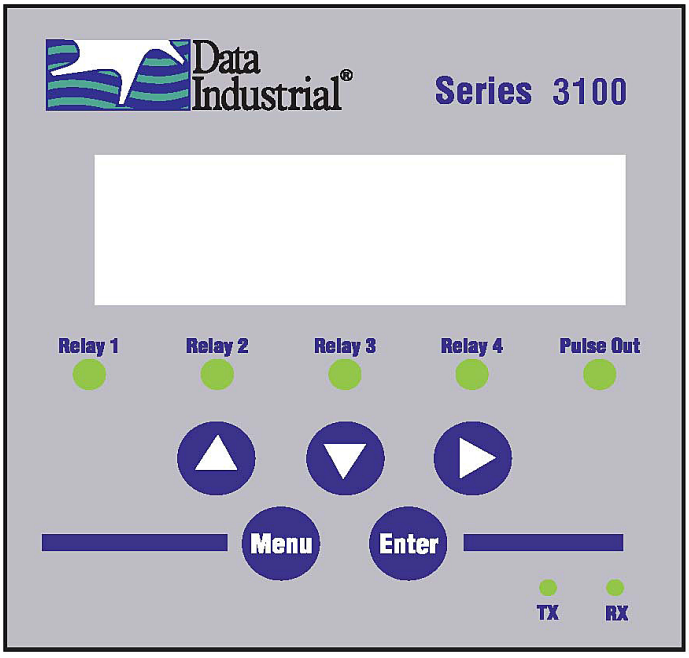
Impeller
Data Industrial®

Data Industrial® Series 3100

Dual Channel Monitor/Controller/Transmitter



Badger Meter

CTL-UM-01026-EN-04 (August 2014)

User Manual

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INTRODUCTION

The Series 3100 Monitor is an economical, dual channel, full featured, digital rate and totalizing monitor, compete with set-point control, scaled pulse output, analog outputs, analog PID controller, USB, and RS485 Modbus and BACnet communication.

Panel mount is NEMA4X-rated, and conforms to DIN standard dimensions (96 mm x 96 mm) for meter size and panel cutout. An optional NEMA 4 wall mount will be available in the future.

The back-lit, two-line by 16-character alphanumeric display can be configured by the user with factory preset or with user-defined units of measure. Any combination of two rates or totals from either input channel can be displayed at any one time, with the special feature of channel addition or subtraction. LEDs report relay status and digital communication.

Inputs are from any combination of two pulse, sine wave or linear analog input devices.

Configuration is menu driven using the LCD/keypad interface, or USB computer connection, with multiple password gates to prevent unauthorized access, while allowing access to select features such as total and relay reset functions.

Outputs include four Form C mechanical relays, one solid-state switch, two Analog Outputs, one USB, and one RS-485 with BACnet and Modbus protocols.

Advanced Standard Features

- Easy to switch power supplies from 12…24V AC/DC to the optional 120/240V AC.
- Nonvolatile memory; no battery backup is required.
- Two independent pulse and analog input channels can be used separately or combined in addition or subtraction modes, for all display output functions.
- Field-definable custom units of measure labeling and conversion factors.
- Two line by 16-character 3/8" (7.95mm) high back-lit display.
- Front panel LEDs indicate status of each relay, pulse output, and Rx/Tx activity.
- Simple front panel configuration with the option to use the USB port.
- USB communication is a very powerful diagnostic and OEM tool.
- Two level password protection; one to restrict setup access and one to protect totals.
- Field-definable custom units of measure labeling and conversion factors.
- A total of seven independent relay, pulse and analog outputs.
- Powerful set-point control, with independent set and release point values, set and release delays, and latching functions
- Scaled pulse output with pulse width control.
- Dual channel analog outputs are either current sinking or sourcing 4…20 mA or 0…20 mA. Current sourcing 0…20 mA permits external conversion to 0…5V DC or 0…10V DC.
- PID process control using analog outputs.
- RS-485 with Modbus and BACnet/MSTP protocols.
- IIFR (Infinite impulse response filter). Proprietary input signal smoothing.

3100 Series Ordering Matrix					
	Example:	3100	-	x	x
Series	Flow Monitor	3100	-		
Power Supply	Low Voltage 12…24V AC/VDC			0	
	High Voltage 120/240V AC			1	
Mounting	Panel Mount				0

Figure 1: Ordering matrix

INSTALLATION

Mechanical

The Badger Meter Series 3100 can be either panel mounted or wall mounted. In any mounting arrangement the primary concern is easy viewing, and convenient operation of the keypad. The unit generates very little heat, so no consideration to cooling is necessary. However, prolonged direct sunlight can damage the front panel so some level of shading is recommended, especially if installed in a tropical climate.

Panel Mount

The Model 3100 Panel Mount is designed for through panel mounting, which allows access to the back of the unit. The 3100 is secured to the panel by two draw brackets shown in Figure 2 below.

Wall Mount

Badger Meter does not currently offer a wall mount enclosure for this product. However, Model 3100 can be field wall mounted, into any appropriate customer supplied enclosure.

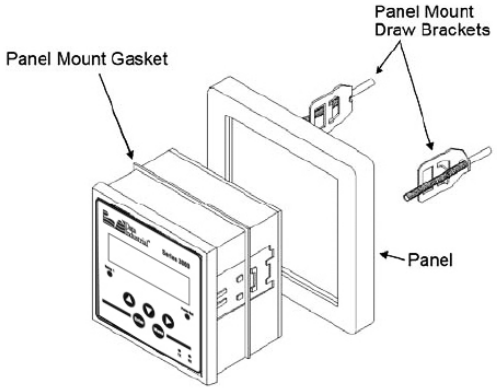


Figure 2: Panel mounting

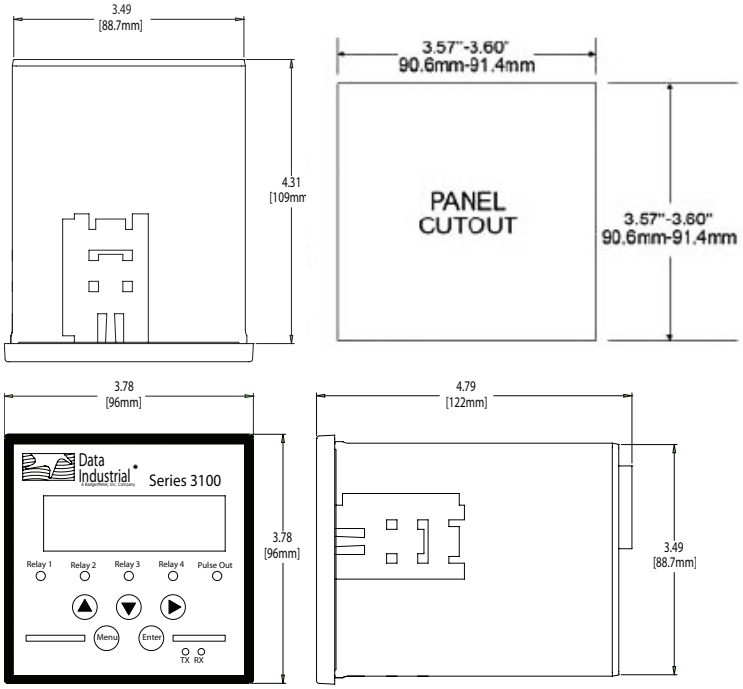


Figure 3: Physical dimensions and panel cut-out

Electrical Power

IMPORTANT

Before applying power to this unit check the Model # label: The Series 3100 can be ordered as low voltage 12…24V AC/DC (3100-0x); or, high voltage 120/240V AC (3100-1x).

Low Voltage 12-24V AC/DC Wiring

The Series 3100 has a green, three-terminal connector with screw heads, and requires 12…24V AC/DC to operate. See *"Specifications" on page 27* for the current DC draw and AC Volt-Amp requirements. A fused circuit is always recommended.

Connect the positive end of the power supply to the Series 3100 terminal marked LV AC/DC (+), and connect the negative end of the power supply to the Series 3100 terminal marked "LV AC/DC" (-). Earth ground can be connected, to the terminal marked "EARTH".

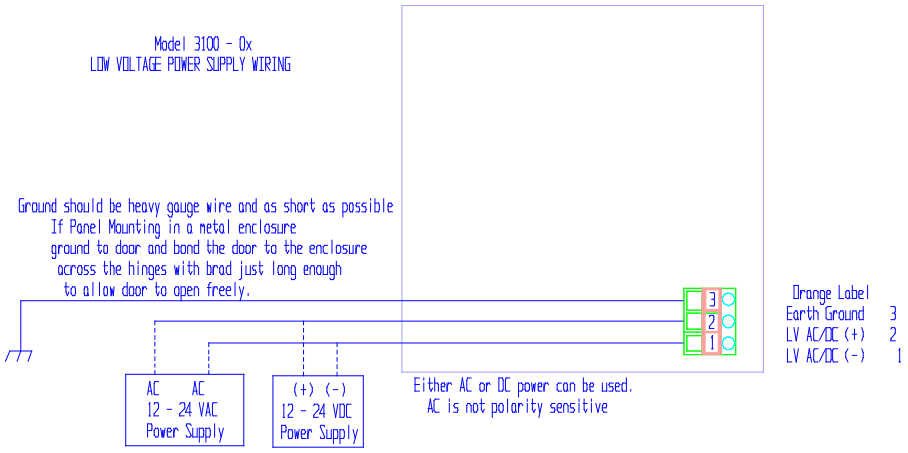

Model 3100 - 0x
LOW VOLTAGE POWER SUPPLY WIRING
Ground should be heavy gauge wire and as short as possible
If Panel Mounting in a metal enclosure
ground to door and bond the door to the enclosure
across the hinges with brad just long enough
to allow door to open freely.
3
2
1
Orange Label
Earth Ground 3
LV AC/DC (+) 2
LV AC/DC (-) 1
AC AC
12 - 24 VAC
Power Supply
(+) (-)
12 - 24 VDC
Power Supply
Either AC or DC power can be used.
AC is not polarity sensitive

Figure 4: Low voltage power supply wiring

High Voltage Power Supply Wiring

The Series 3100-1x is designed to accept a standard EL-712 (NEMA 5-15R) plug similar to ones used on many laptop computers. Power can be 120…240V AC 50…60 Hz. When the High Voltage option is ordered (3100-1x), a power cord is supplied with the unit.

See *"Specifications" on page 27* for volt/amp ratings for inverter or other non-conventional source.

Input Sensor Wiring

The Series 3100 is a Dual Channel unit. Either a single input, or any combination of two Pulse or Analog inputs can be used. The pulse inputs are extremely versatile, designed to accept either two-wire (Data Industrial 200 Series), three-wire pulse inputs (4000 series) or zero-crossing sine wave inputs (turbines with a magnetic coil pick-up).

The analog inputs can accept 0…20 mA, 4…20 mA, 0…1V DC, 0…5V DC, or 0…10V DC. Both the top and bottom ends of the analog range can be configured in the field so that most inputs can be accepted if the hardware limitations are not exceeded. Contact the factory for assistance with custom inputs. Although different rear panel terminals are used, all parameters are set with the LCD/keypad interface. No internal or external jumpers, switches or potentiometers require movement or adjustment.

Pulse Inputs (Solid State Switch or Sine Wave)
Four types of pulse input types are accommodated.

- Pulse-DI: Used for all Data Industrial Flow Sensors. Provides an internal pull-up resistor and uses "K" and "Offset" values for calibration.
- Pulse –K Factor: Accepts non Zero Crossing inputs but provides no internal pull-up, classical "K" (pulses/gal) values for calibration.
- Pull-up K Factor: Provides an internal pull-up resistor and uses classical "K" (pulses/gal) values for calibration.
- Sine-K Factor: Accepts zero crossing low voltage sourcing devices, with classical "K" (pulses/gal) calibration.

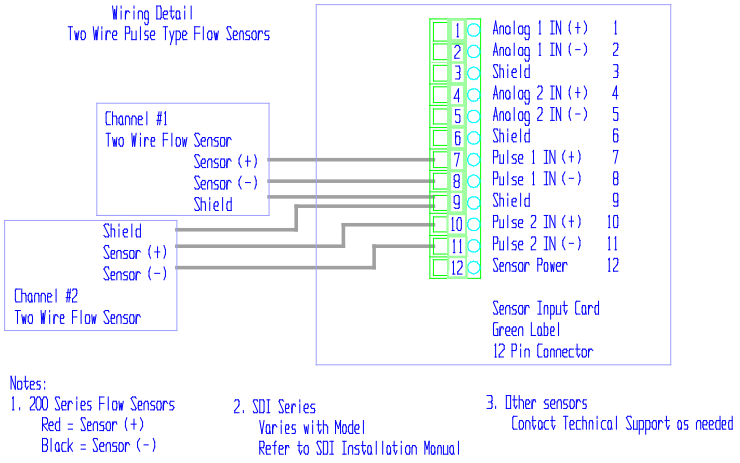


Figure 5: Two-wire pulse flow sensor

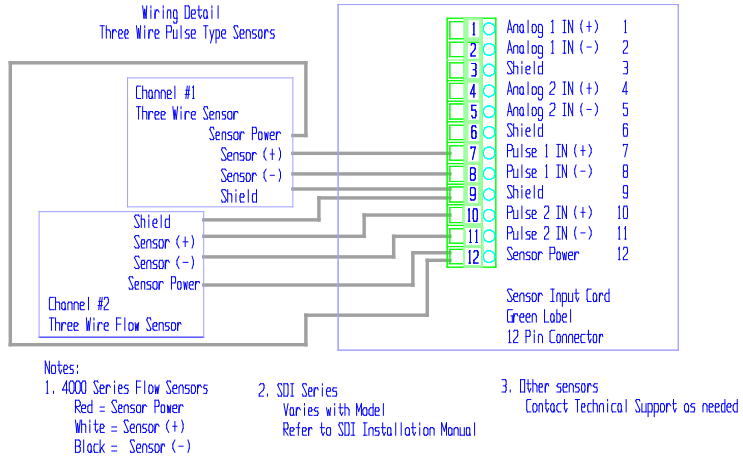


Figure 6: Three-wire pulse sensor

Analog Input

As an alternative to the pulse inputs the Badger Meter Series 3100 can accept up to two analog inputs. The input is non-isolated, but can accept 0…1V DC; 0…5V DC; 0…10V DC; 0…20 mA; and 4…20 mA with both factory defined, and custom units of measure. Low impedance 100 ohm input for current inputs optimizes performance and flexibility for loop power supplies. Both the low and high end scaling are independent and field configured by the installer.

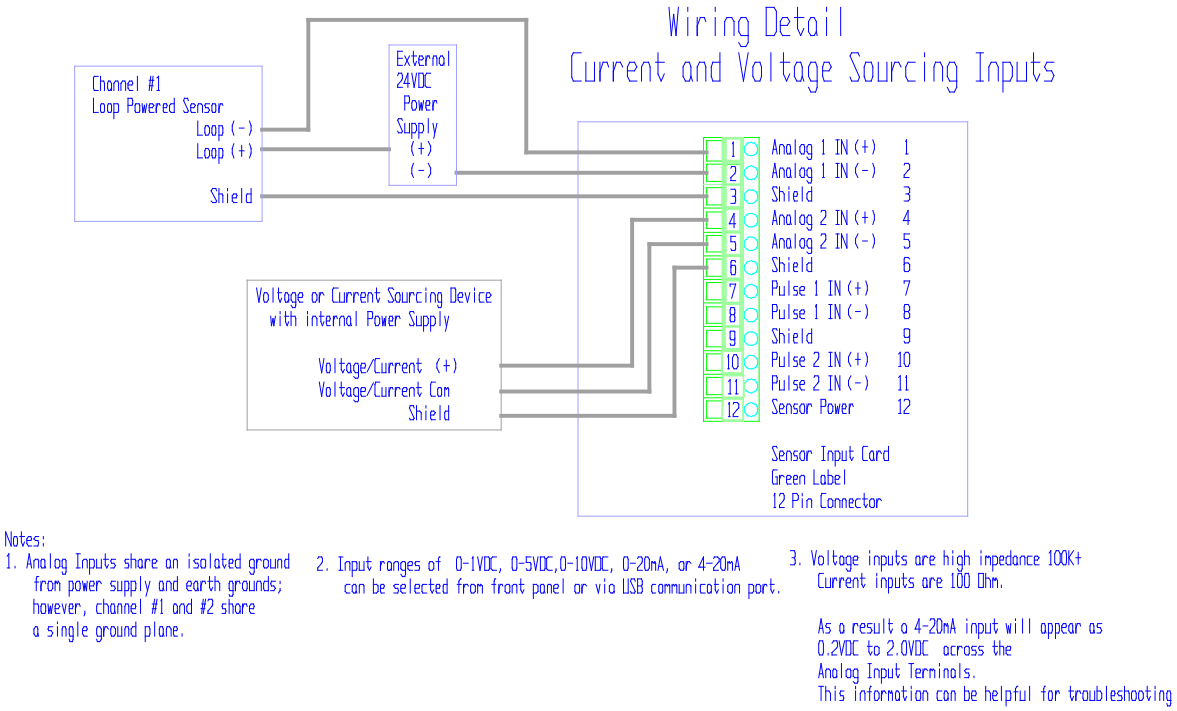

Wiring Detail
Current and Voltage Sourcing Inputs
Channel #1
Loop Powered Sensor
Loop (-)
Loop (+)
Shield
External
24VDC
Power
Supply
(+)
(-)
Voltage or Current Sourcing Device
with internal Power Supply
Voltage/Current (+)
Voltage/Current Com
Shield
1 Analog 1 IN (+) 1
2 Analog 1 IN (-) 2
3 Shield 3
4 Analog 2 IN (+) 4
5 Analog 2 IN (-) 5
6 Shield 6
7 Pulse 1 IN (+) 7
8 Pulse 1 IN (-) 8
9 Shield 9
10 Pulse 2 IN (+) 10
11 Pulse 2 IN (-) 11
12 Sensor Power 12
Sensor Input Card
Green Label
12 Pin Connector
Notes:
1. Analog Inputs share an isolated ground from power supply and earth grounds; however, channel #1 and #2 share a single ground plane.
2. Input ranges of 0-1VDC, 0-5VDC,0-10VDC, 0-20mA, or 4-20mA can be selected from front panel or via USB communication port.
3. Voltage inputs are high impedance 100K+ Current inputs are 100 Ohm.
As a result a 4-20mA input will appear as 0.2VDC to 2.0VDC across the Analog Input Terminals.
This information can be helpful for troubleshooting

Figure 7: Current and voltage sourcing inputs

Output Wiring

The Series 3100 has four mechanical form "C" relays, one solid state, normally open (N.O.) switch closure, two analog outputs, RS-485 for Modbus and BACnet communications and a USB connector for configuration and other purposes.

See *"Specifications" on page 27* for maximum voltage and current ratings for each type output.

Mechanical Form "C" Relay (COM, N.O. and N.C.)

The four form "C" mechanical relays are labeled "NO" (normally open), "NC" (normally closed) and COM (common).

When a relay is de-energized, the corresponding LED is unlit, and continuity exists between N.C. and COM; and, N.O. to COM is open.

When a relay is energized the corresponding LED lights yellow and there is continuity between N.O. and COM and N.C. to COM is open.

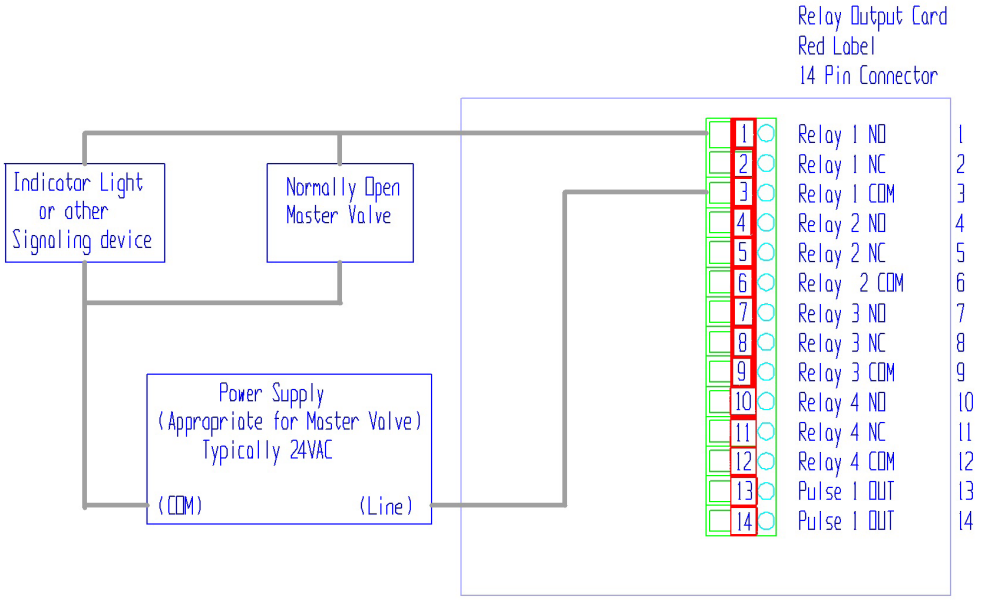
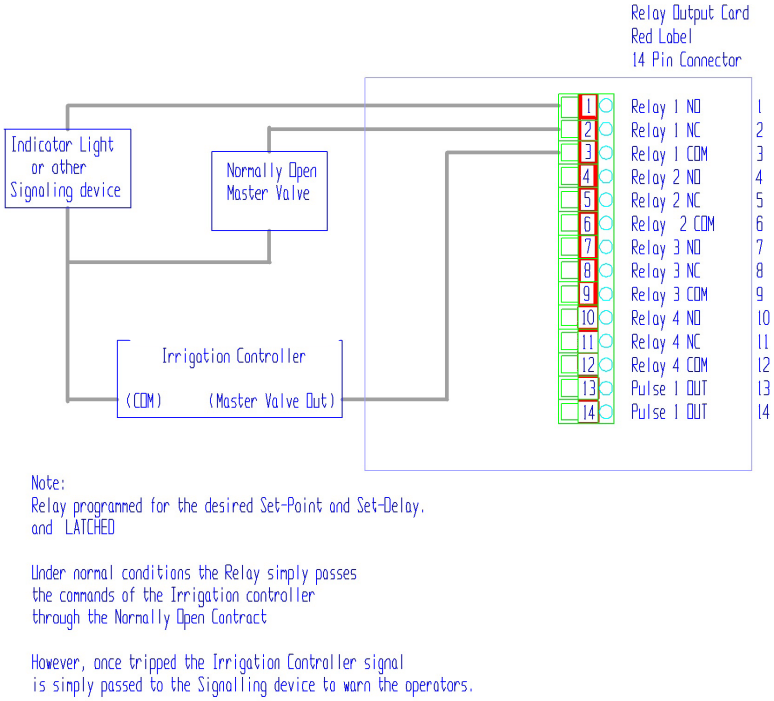


Figure 8: High flow shut-down and normally open master valve



Note:
Relay programmed for the desired Set-Point and Set-Delay.
and LATCHED

Under normal conditions the Relay simply passes
the commands of the Irrigation controller
through the Normally Open Contract

However, once tripped the Irrigation Controller signal
is simply passed to the Signalling device to warn the operators.

Figure 9: High flow shut-down with irrigation clock and normally closed master valve

Normally Open Solid Switch

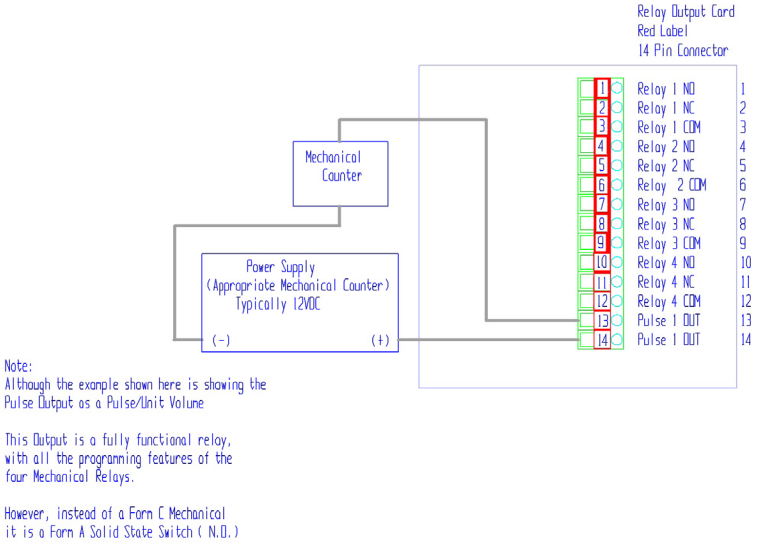


Figure 10: External mechanical counter and power supply

The pulse output is a completely programmable, isolated N.O. solid state switch.

It is a non-polarized device that can handle either DC or AC loads. See *"Specifications" on page 27* for voltage and load limitations.

Analog Outputs

The Series 3100 has two analog outputs. Each is isolated and independent and can be configured for 0…20 mA or 4…20 mA. This unique design permits external conversion to externally to 0…5V DC or 1…5V DC with a 250 ohm resistor or 0…10V DC or 2…10V DC with a 500 ohm resistor.

A 15V DC power supply is provided to permit current sinking or sourcing. If additional source voltage is required, an external source of up to 30V DC can be used.

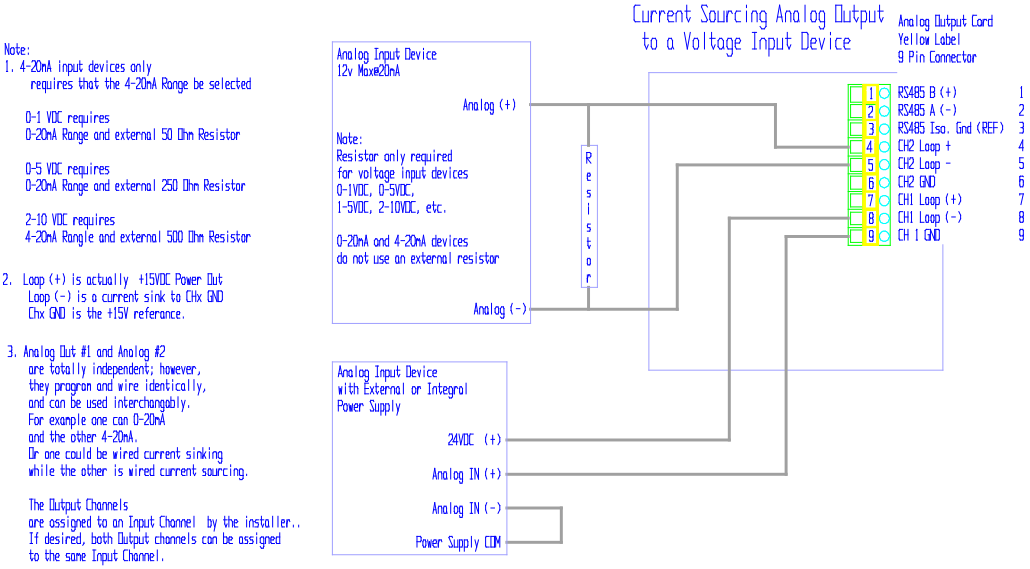

Current Sourcing Analog Output
to a Voltage Input Device
Analog Output Card
Yellow Label
9 Pin Connector
RS485 B (+)
RS485 A (-)
RS485 Iso. Gnd (REF)
CH2 Loop +
CH2 Loop -
CH2 GND
CH1 Loop (+)
CH1 Loop (-)
CH 1 GND
Analog Input Device
12v Maxe20mA
Analog (+)
Analog (-)
Resistor
Note:
Resistor only required
for voltage input devices
0-1VDC, 0-5VDC,
1-5VDC, 2-10VDC, etc.
0-20mA and 4-20mA devices
do not use an external resistor
Analog Input Device
with External or Integral
Power Supply
24VDC (+)
Analog IN (+)
Analog IN (-)
Power Supply COM
Note:
1. 4-20mA input devices only
requires that the 4-20mA Range be selected
0-1 VDC requires
0-20mA Range and external 50 Ohm Resistor
0-5 VDC requires
0-20mA Range and external 250 Ohm Resistor
2-10 VDC requires
4-20mA Rangle and external 500 Ohm Resistor
2. Loop (+) is actually +15VDC Power Out
Loop (-) is a current sink to CHx GND
CHx GND is the +15V referance.
3. Analog Out #1 and Analog #2
are totally independent; however,
they program and wire identically,
and can be used interchangably.
For example one can 0-20mA
and the other 4-20mA.
Or one could be wired current sinking
while the other is wired current sourcing.
The Output Channels
are assigned to an Input Channel by the installer..
If desired, both Output channels can be assigned
to the same Input Channel.

Figure 11: Current sourcing analog output to voltage input device

RS-485 Communication Wiring

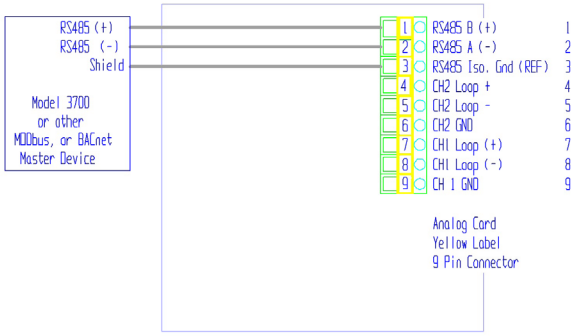


Figure 12: RS-485 communication wiring (Modbus + BACnet)

USB Communications Port

Using the USB Port requires Windows® HyperTerminal or other similar communications software.

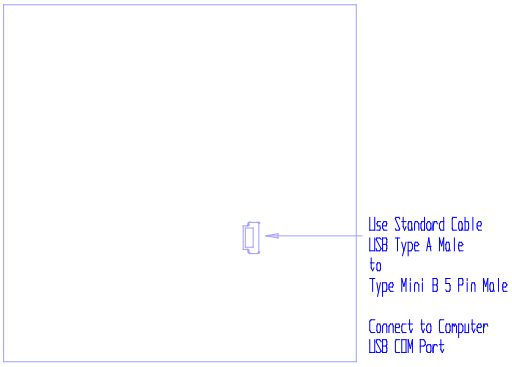


Figure 13: USB port

PROGRAMMING

Programming Flow Charts - Relays

The following block diagrams explain various programming areas and are organized as follows:

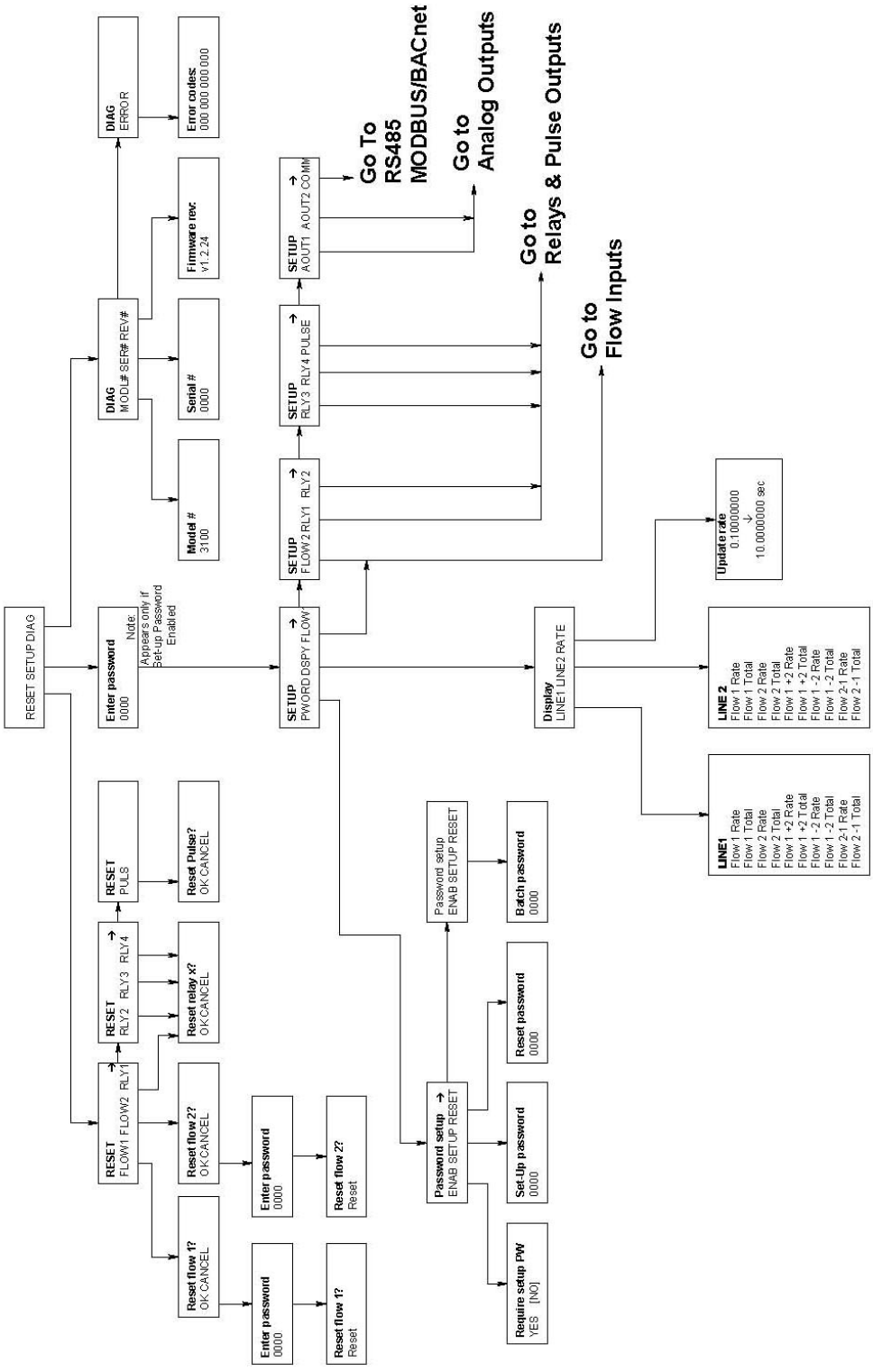


Figure 14: Model 3100 programming chart

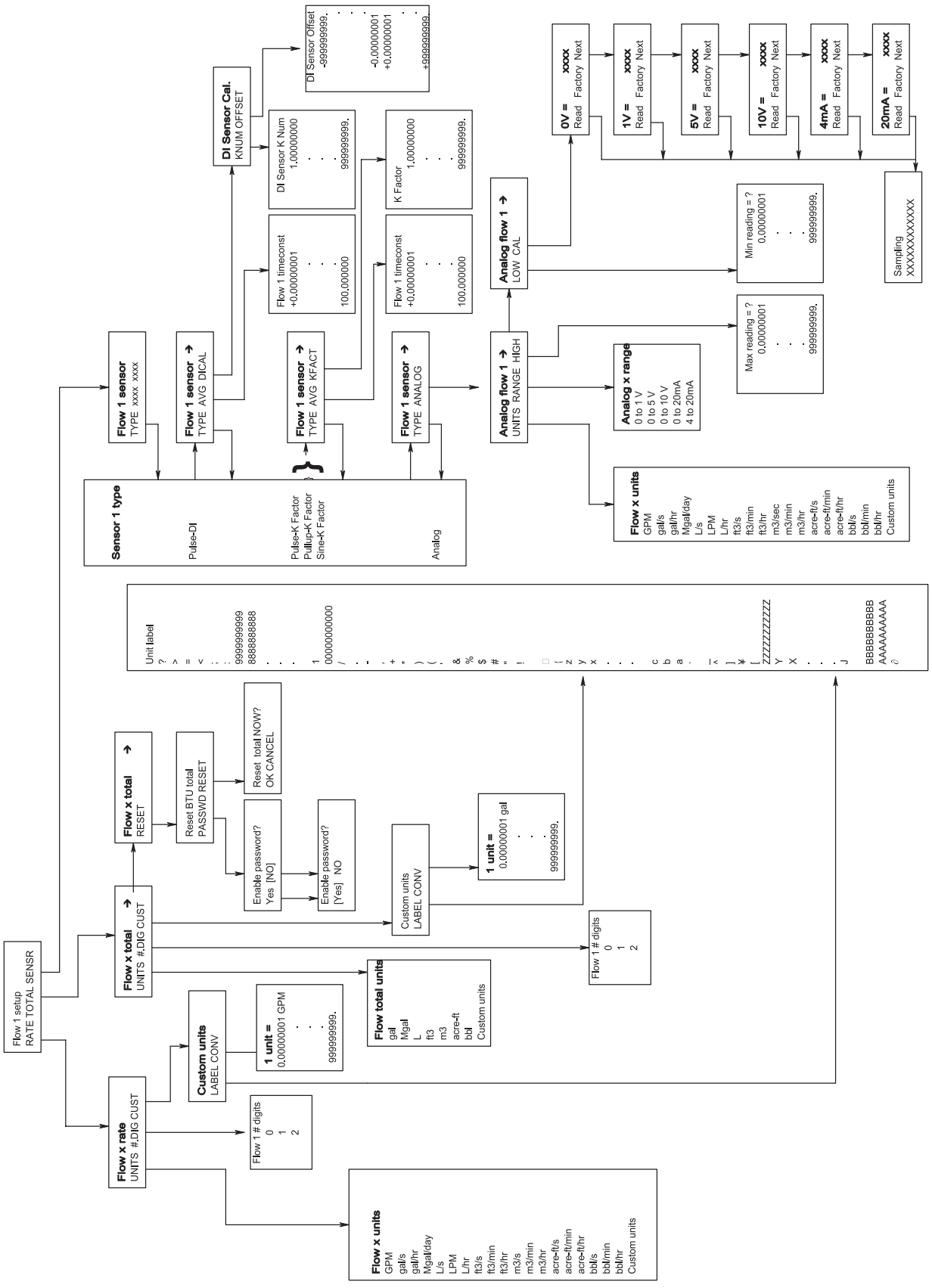


Figure 15: Flow inputs

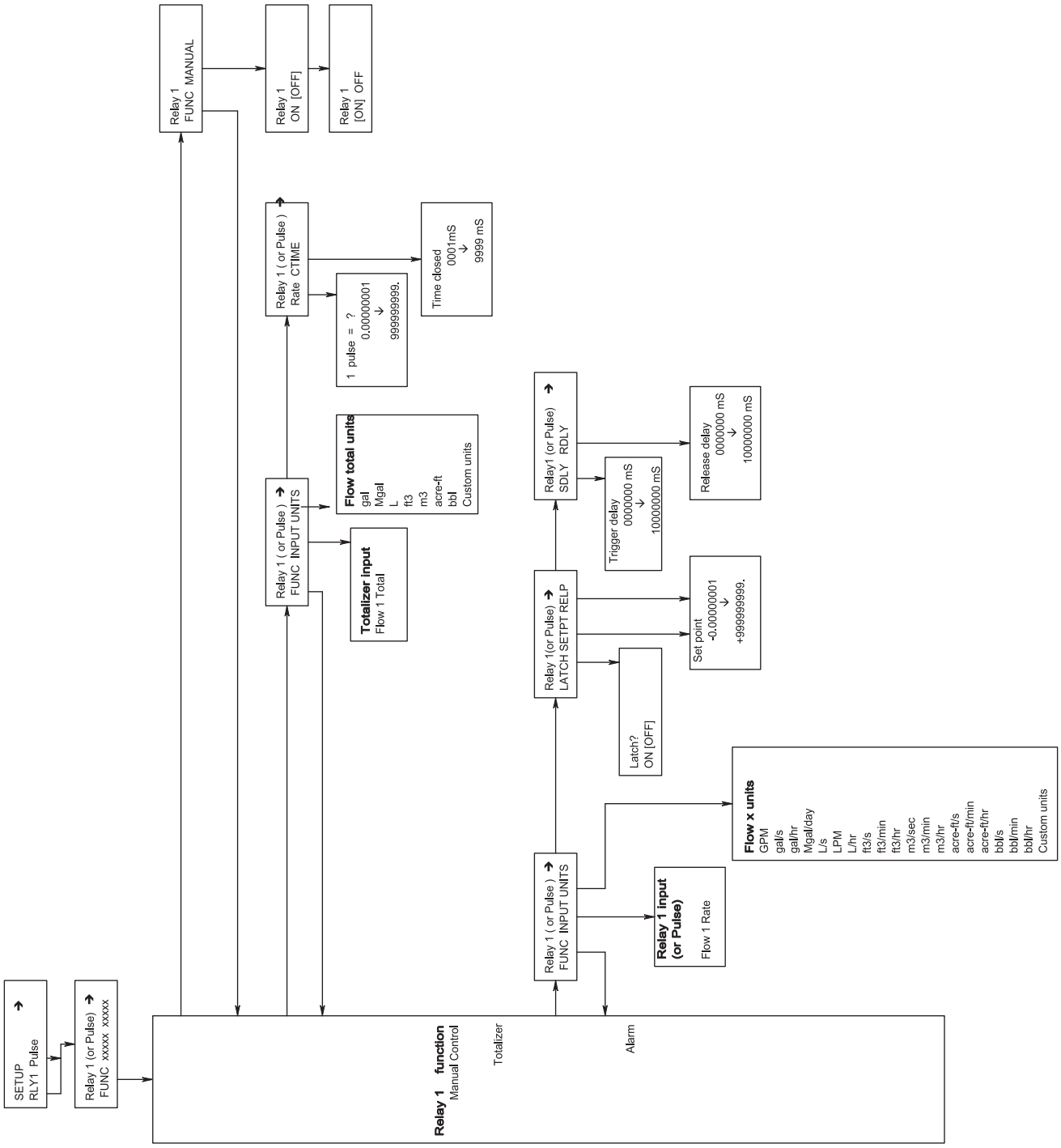


Figure 16: Relays & pulse outputs

Figure 17: Analog inputs

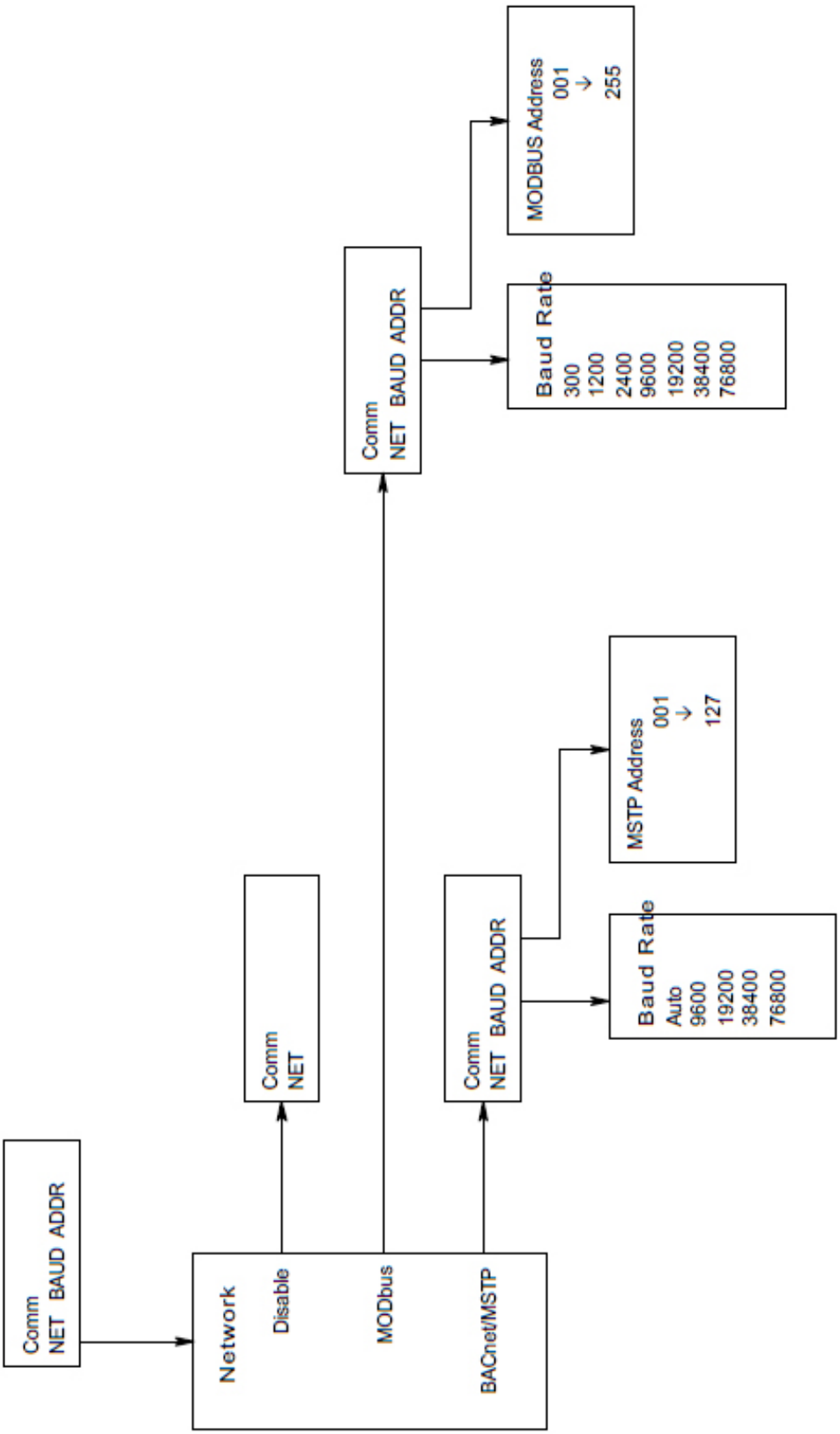


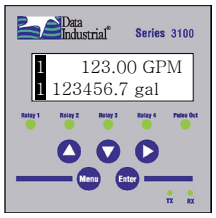
Figure 18: RS-485 communication port

Key Pad/Display Menu Navigation

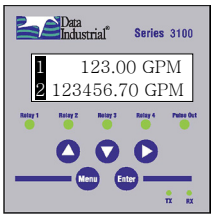
The Model 3100 Monitor has a two line by 16-character display with two modes of operation and 5 keys on the front panel for programming. Two of the keys (Menu and Enter) serve a single function while the three remaining keys (▲▼▶) serve dual purposes.

When the Model 3100 is first powered up, it performs internal testing, while displaying "Badger Meter DIC Initializing." At the end of the internal testing cycle, the main display will appear.

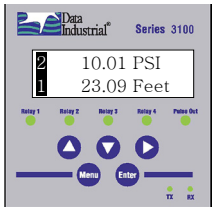
In the normal mode, if still using the factory defaults, flow rate will be displayed on the top line and flow total displayed on the bottom. Both lines can be custom defined in the field as desired. In the normal mode, **ENTER** has no function.



Flow Channel 1 Flow Rate and Flow Total



Flow Channel 1 Flow Rate and Flow Channel 2 Rate



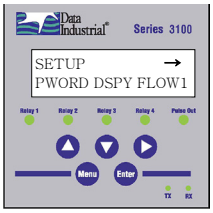
Channel 2: Pressure and Channel 1: Level

Main Set-up screen accessed by press **MENU**

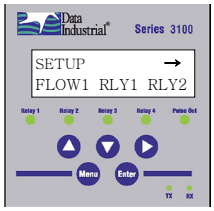
One each screen there are three choices

(In this case RESET SETUP and DIAG)

▲selects *RESET* ▼ selects *SETUP* and ▶ selects *DIAG*



As seen in the previous figure, on every screen there are three choices, and three corresponding buttons. However, on this menu "Set-up" there are more choices than fit on the screen. The is indicated by the " →". To access these remaining choices press **ENTER**.



Pressing **ENTER** again to bring up the next set of choices, and so on.

Press **MENU** to exit section, back to the previous screen, or in some cases back to the main display screen.

Selection Screens

Press **MENU** to access to the programming mode, while the normal display is shown. In this mode, the three arrow keys (▲▼▶) are used in the selection screens options displayed above the key. Option list screens are used to scroll up or down through a list of choices, like a pull-down menu. Note that most screens presenting choices show three choices, one for each arrow button. When the number of choices exceeds three, a small arrow (→) appears in the upper right side of the display to indicate more choices on that level. Press **ENTER** to toggle to the next set of choices. Once a selection has been made, press **ENTER** to complete the selection. Press **MENU** to return to the Normal screen. For example: Press **MENU** from the Normal screen to display the "*RESET SETUP DIAG*" screen.
Press ▲ to display the Reset Screens, ▼ to display the Setup Screens and ▶ to display the Diagnostic Screens. If ▼ is pressed, the following screen will appear:

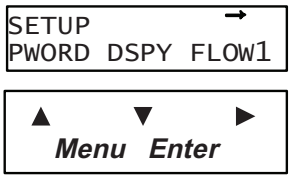


Figure 19: Selection screen

Option List Screens

Units of measure is an example of an options list.

Press ▲ to scroll up the list, and ▼ to scroll down through the list. In this case starting with GPM; gal/s; gal/hr; LPM; ending in a selection of custom units. Press **ENTER** to complete the selection. Press **MENU** to leave the selection unchanged.

The ▶ key has no function on this type of screen.

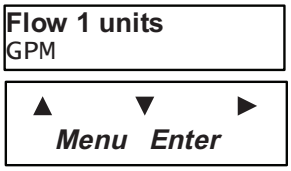


Figure 20: Options list screen

Data Entry Screens

Some screens are data entry screens, such as set points or custom units. When a data screen is initially displayed, the current value will be displayed. The cursor will be flashing the left-most digit. Press ▲ to increase a value, and ▼ to reduce a value.

If the cursor is flashing on the decimal point, press ▲ to move the decimal point to the right, press ▼ to move the decimal to the left.

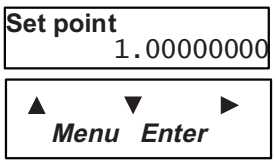


Figure 21: Data entry screen

Solid State Switch and Form "C" Outputs

The four form C mechanical relays, and one N.O. solid state switch pulse output are completely independent, electrically isolated and can be programmed as either pulse or set-point outputs.

Totalizer – Pulse Output

When the function "Totalizer" is selected the unit of measure and resolution are independent from the displayed units, and can be programmed where 1 pulse occurs once every 0000000.1 to 999999999 of units selected, with any pulse width from 0001 to 9999 mS.

Set Points

The Set Point programming is extremely powerful and flexible, with unit of measure and resolution independent from the displayed units. Since the Set Point, Release Point and their associated time delays are fully independent, the alarm can be either a high rate or low rate, depending on whether the Set Point is selected greater than the release point, or the release point is greater than the Set Point. For applications where the relay must remained energized, once set, a latching feature is provided. When latched, the relay remains energized until reset from the front panel. While design planning, note that both the relays and the pulse outputs can be programmed as alarm points and only the relays provide both normally open and normally closed contacts. The switch is a simple N.O. contact.

Terminology

Display	Definition	Function
SETPT	Set point	If the set point value is a greater than the release point value, when the displayed flow rate exceed the set point, the Set Point Delay Timer is started. If the set point is less than the release point when the flow drops below the set point, the timer is started
SDLY	Set point time delay	If the set point remains crossed for a continuous period of time exceeding the set point delay setting, the relay will energize. If the flow rate briefly re-crosses the set point before the timer reaches its setting, the timer will reset and await another set point crossing before restarting the count from zero.
LATCH	Locks relay in energized state	If *Latch* is chosen, once energized by the set-point time delay, the relay will remain energized until reset from the front panel. Otherwise, the relay will de-energize when the Release Point Delay Timer times out.
RELP	Release point	If the relay is already energized, not latched and the flow input crosses the release point, the Release Point Delay timer is started.
RDLY	Release point time delay	If the release point remains crossed for a continuous period of time and exceeds the release point delay setting, the relay will de-energize. If the flow rate briefly re-crosses the release point before the timer reaches its setting, the timer will reset and await another release point, crossing before restarting the count from zero.

High Flow Set Point
The *SETPT* must be a value greater than the *RELP*. The relay output will have continuity between its *N.C.* terminal and *COM* until the flow has exceeded the *SETPT* for a continuous period of time exceeding the *SDLY*. At this time, the N.C. connection will open and the N.O. contact will have continuity to the *COM* terminal. When the flow has dropped below the *RELP* for a continuous period of time exceeding the *RDLY*, the relay states will return to their original states. If the latch has been set to *ON* once the set point and set delay have been satisfied, the relay will not release until manually reset.

Low Flow Set Point
The *SETPT* must be a value less than the *RELP*. The relay output will have continuity between its *N.C.* terminal and *COM* until the flow drops below the *SETPT* for a continuous period of time exceeding the *SDLY*. At this time, the N.C. connection will open and the N.O. contact will have continuity to the *COM* terminal. When the flow has again risen above the *RELP* for a continuous period of time, exceeding the *RDLY*, the relay states will return to their original states. If the latch has been set to *ON* when the set point and set delay have been satisfied, the relay will not release until manually reset.

Communication

RS-485 COM Port Configuration

The RS-485 is very simple to configure.

1. Select the communications type: Modbus or BACnet.
2. Choose the BAUD Rate: Auto, 300, 1200, 2400, 9600, 19200, 38400, or 76800 to match the rest of the devices on the network. The factory default of 9600 is recommended for most systems. The lower the baud rates have greater stability, and greater tolerance of wiring and other hardware issues.
3. Configure the Modbus or BACnet are described in there respective sections.

Modbus

Network: RS485
Baud Rate: Selectable
Protocol: RTU or ASCII
Addresses: 001 to 248
Slave only
Read Input Registers 30001- 39999 (Function "04")
Data Type: IEEE 754 Float (ABCD – CDAB)
Each variable is stored in two Modbus registers; lowest byte in the first and highest in the second.
Only the variable value is transmitted.
The associated units of measure must be manually configured in the receiving Modbus device.

1	Flow 1 Rate	(Input Register 30002 + 30003)
2	Flow 2 Rate	(Input Register 30004 + 30005)
3	Flow 1 Total	(Input Register 30006 + 30007)
4	Flow 2 Total	(Input Register 30008 + 30009)

BACnet

The Model 3100 can be configured to communicate on a BACnet RS-485 MSTP (Master Slave Token Passing) system. Configuration is via the front panel key pad.

The following settings are required

- Baud Rate: [9600;19200;38400; or 76800]. The recommended factory default is 9600.
- MSTP Address: [0-127]. Each device must have a unique address.
- MSTP MAX master: [0-127]. This range must be greater than the highest address on the network.
- Device Instance: [00000000-99999999]. This is a unique identifier for each device in the system.

Object Name	I/O (Write/Read)	Object Type	Object ID	Units
BACnet Address	I/O	Analog Value	AV1	
BACnet BaudRate	I/O	Multi-State	MSV1	See Note 1
Flow 1 Rate	O	Analog Input	AI1	Same as Displayed
Flow 2 Rate	O	Analog Input	AI2	Same as Displayed
Flow 1 Total	O	Analog Input	AI3	Same as Displayed
Flow 2 Total	O	Analog Input	AI4	Same as Displayed

Note 1: 0 = Auto, 1 = 9600, 2 = 19200, 3 = 38400, 4 = 76800
Note 2: Units of measure are selected by installer from a list of pre-programmed units, or as custom units created by the installer. BACnet will transmit in the same units as displayed on the Model 3100 front panel LCD.

USB Communication

The Series 3100 Flow Monitor is ordered with an analog output option card. A five-pin USB connector is also included. As much as possible, the commands mimic the use of the front panel controls.

To use this feature, the following are required.

1. PC with USB ports and Windows HyperTerminal or other communications software
2. FTDI Virtual COM port drivers http://www.ftdichip.com/FTDrivers.htm
3. USB 2.0 A to Mini-B 5-pin cable

To communicate using HyperTerminal, use the following procedure.

1. Make sure that the Series 3100 has a Mini-B five-pin connector on the back panel. (The Series 3100 must have an analog output option card installed and will be marked Series # 3100-1x).
2. Be sure the appropriate FTDI Virtual COM port drivers are installed on your computer.
3. Plug the USB 2.0 A end of the cable into an available USB port on your computer. Plug the Mini-B five-pin end into the back of the Series 3100.

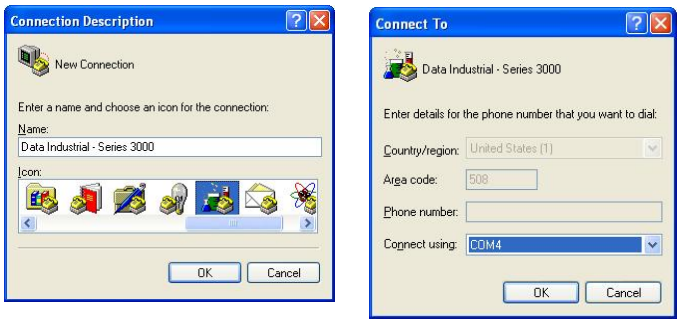


Figure 22: Hyper terminal connection screens

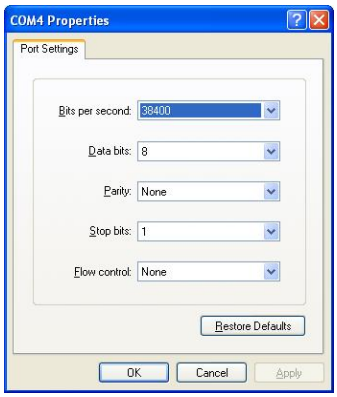


Figure 23: COM4 properties screen

4. Press **ENTER**. Both the Rx and Tx LEDs on the front of the Series 3100 should flash once and the "Badger Meter DIC … Software Version…" text message should appear.
5. The Series 3100 is now communicating and ready to take commands from the list below.

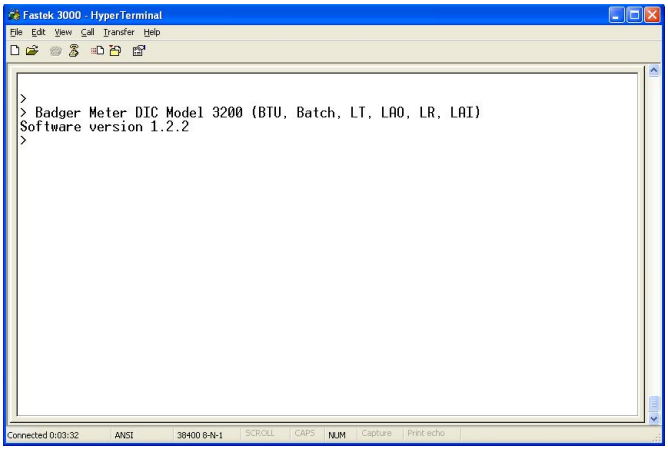


Figure 24: Communication ready status screen

USB Command List

In the list below, brackets indicate an argument, specifying its type and value range.

For instance [0-18] stands for any number between 0 and 18 (inclusive).

Example:
"display line1 = 1" sets Line 1 of the display to display #1, which happens to be the totalizer for flow channel 1.

Diagnostics

id -- show model number & software version
echo [on/off] -- turn on/off interactive command line:
with echo off, this interface is more amenable to scripting;
it still accepts the same commands.
Any command entered without an " = " sign and variable will display the current setting.
Example: Typing "display line 1" returns "0" which is the variable for flow rate
read flow [1-2] -- read the current flow on channel 1 or 2 in GPM
read flow [1-2] total -- read the current total flow on channel 1 or 2 in gallons
comm mstpaddr = [0-127] -- BACnet/MSTP address
comm maxmaster = [0-127] -- BACnet/MSTP max master address
comm devinst = [x] -- BACnet device instance ID
comm mbslaveaddr = [0-255] -- Modbus slave address

Display Configuration

display line 1 = [0-1] -- set line 1 of the display
display line 2 = [0-1] -- set line 2 of the display
0: flow 1 rate
1: flow 1 total
3: flow 2 total
4: flow 1+2 rate
5: flow 1+2 total
6: flow 1-2 rate
7: flow 1-2 total
8: flow 2-1 rate
9: flow 2-1 total
display urate = [0.1-10] -- set the update rate of the display, in seconds

Input Channel Configuration

flow [1-2] sensor type = [0-4] -- flow sensor type:
- 0: PulseDI,
- 1: PulseKFactor
- 2: PullupKFactor*
- 3: SineKFactor*
- 4: Analog*

flow [1-2] sensor dical k = [x] -- DI-type flow sensor k
flow [1-2] sensor dical off = [x] -- DI-type flow sensor offset
flow [1-2] sensor kfact = [x] -- K factor for non-DI sensors
flow [1-2] sensor analog units = [0-19] -- flow units for analog input
flow [1-2] sensor analog range = [0-4] -- current range for analog input
flow [1-2] sensor analog high = [x] -- flow rate @max current
flow [1-2] sensor analog low = [x] -- flow rate @min current
flow [1-2] sensor avg = [0-100] -- averaging "time constant", in seconds:
flow [1-2] rate units = [0-19] -- flow (channel) rate units to display.
- 0: GPM
- 1: gal/s
- 2: gal/hr
- 3: Mgal/day
- 4: L/s
- 5: LPM
- 6: L/hr
- 7: ft3/s
- 8: ft3/min
- 9: ft3/hr
- 10:m3/s
- 11:m3/min
- 12:m3/hr
- 13:acreft/s
- 14:acreft/min
- 15:acreft/hr
- 16:bbl/s
- 17:bbl/min
- 18:bbl/hr
- 19:Custom

flow [1-2] rate ndigits = [2-10] -- number of decimal places to show for flow rate
flow [1-2] rate custom label = [string] -- set the label for custom units
flow [1-2] rate custom conv = [0-100] -- conversion factor for custom units
flow [1-2] total units = [0-7] -- set the totalizer units to display.
- 0: gal
- 1: Mgal
- 2: L
- 3: ft3
- 4: m3
- 5: acreft
- 6: bbl
- 7: Custom

Relay Output Configuration

relay [1-5] func = [0-9] -- relay function; relay 5 is the pulse output
- 0: Totalizer
- 1: Alarm
- 2: Manual Control

relay [1-5] input = [0-8] -- relay input; depends on source for totalizer:
- 0: Flow 1 Total
- 1: Flow 2 Rate
- 2: Flow Sum Rate
- 3: Flow 1-2 Rate
- Flow 2-1 Rate

for alarms:
- 0: Flow 1 Rate
- 1: Flow 2 Rate
- 2: Flow Sum Rate
- 3: Flow 1-2 Rate
- 4: Flow 2-1 Rate

relay [1-5] units = [0-19] -- units on setpoints/rates; depends on src/input
flow units: same as 'flow [1-2] rate units' above
volume units: same as 'flow [1-2] total units'
relay [1-5] manual = [on/off] -- manually set relay on or off, if in manual mode
relay [1-5] rate = [x] -- totalizer rate
relay [1-5] ctime = [0-10000] -- pulse width in milliseconds
relay [1-4] latch = [on/off] -- turn on/off relay latching
relay [1-4] setpoint = [x]
relay [1-4] setpoint = [x]
relay [1-4] relpoint = [x]
relay [1-4] setdelay = [x]
relay [1-4] reldelay = [x]

Analog Output Configuration

analogout [1-2] func = [0-3]
- 0: Flow rate
- 3: PID control

analogout [1-2] src = [0-4]
for flow rate:
- 0: Flow 1 rate
- 1: Flow 2 Rate
- 2: Flow sum
- 3: Flow 1-2
- 4: Flow 2-1

for PID control:
- 0: Flow 1 rate
- 1: Flow 2 rate

analogout [1-2] range = [0-1]
- 0: 0-20mA
- 1: 4-20mA

analogout [1-2] low = [x] -- value corresponding to 0 (or 4) mA
analogout [1-2] high = [x] -- value corresponding to 20mA
analogout [1-2] setpoint = [x] -- PID setpoint
analogout [1-2] P = [x] -- PID constants
analogout [1-2] I = [x] -- PID constants
analogout [1-2] D = [x] -- PID constants

TROUBLESHOOTING

Trouble Codes

1	Relay 1 totalizer rate exceeded
2	Relay 2 rate exceeded
3	Relay 3 rate exceeded
4	Relay 4 rate exceeded
5	Pulse out rate exceeded
20	Error reading EEPROM on faceplate
21	Error writing EEPROM
22	Analog Input card missing
24	Temperature Input card missing
25	Invalid flow units configured
26	Invalid volume units configured
27	Bad input frequency
29	Internal error calculating flow rate
31	Error reading from analog input AD converter channel 1
32	Error reading from analog input AD converter channel 2
36	Error writing to analog input AD converter channel 1
37	Error writing to analog input AD converter channel 2
50	Error reading I2C address 0 (relays, buttons, and LEDs)
51	Error writing to I2C address 0
52	Error reading I2C address 1 (analog input card control lines)
53	Error writing I2C address 1
54	Error reading I2C address 2 (temperature input card control lines)
55	Error writing I2C address 2
71	Watchdog timer reset occurred
82	Fatal error initializing EEPROM

SPECIFICATIONS

Voltage	12…24V DC/AC (limit: 8…35V DC); (limit: 8…28V AC)		DC current draw (~ 280 mA) AC Power rating (~5 VA)
Display	16 character by two line alphanumeric Dot Matrix 3/8 in. (7.95 mm) high backlit LCD		
Operating Temperature	–4…158° F (–20…70° C)		
Storage Temperature	–22…176° F (–30…80° C)		
Dimensions	Panel Mount: 3.78 in. W x 3.78 in. H x 4.79 in. D (96 mm x 96 mm x 122 mm)		
Weight	Panel Mount: 12 oz.		
Pulse and Relays	Both pulse and relay are fully functional as either totalizing or set point outputs		
Pulse Electrical	1 Amp at 35V DC/30V AC	**Closed**: 0.5 Ω at 1 amp; **Open**: $>10^8$ Ω	
Relay Electrical	**Resistive Load**: 5A @ 120V AC/30V DC	**Inductive Load**: 1A @ 120V AC/30V DC	
Pulse/Unit Volume (Totalizer)	**Driving Source:** flow total	**Rate:** 1 pulse per 1.0000000 to 99999999 units	**Contact Time:** 1 to 9999 mS
Set-Point (Alarm)	**Driving Source:** flow rate, Btu rate, temperature 1, temperature 2, delta T	**Units**: Any predefined or custom unit	**Set-Point**: 1.0000000 to 999999999
	Delay to Set: 1 to 9999 sec	**Release Point**: 1.0000000 to 999999999	**Delay to Release**: 1 to 9999 sec
Analog Output	**Driving Source**: flow rate	**Range**: 4…20 mA; 0…20 mA (isolated current sinking or sourcing)	**Sinking**: 30V DS @ 0 mA max; 3 V @ 20 mA min **Sourcing**: 600 Ω max load
USB Communication	Provides complete access to all programming and operation features		**Requirements**: USB 2.0 A to Mini-B, five-pin cable
RS-485 Communication	Supports Modbus and BACnet/MSTP		
Accessories	Programming kit		

Flow Sensor Inputs

Type	Threshold	Signal Limit	Frequency	Pull-up	Impedance	Aux. Power	Calibration
Pulse-Di	2.5V DC	30V DC	0.4 Hz to 10 kHz	1K to 12V DC	-	12V DC@30 mA	K + Offset
Pulse-K Factor	2.5V DC	30V DC	0.4 Hz to 10 kHz	-	-	12V DC@30 mA	Pulse/Gal
Pull-up K Factor	2.5V DC	30V DC	0.4 Hz to 10 kHz	1K to 12V DC	-	12V DC@30 mA	Pulse/Gal
Sine-K Factor	-	30V DC	0.4 Hz to 10 kHz	-	10K Ω	12V DC@30 mA	Pulse/Gal
Analog - 4…20 mA	-	50 mA Fused	-	-	100 Ω	12V DC@30 mA	Linear
Analog - 0…20 mA	-	50 mA Fused	-	-	100 Ω	12V DC@30 mA	Linear
Analog - 0…1V DC	-	30V DC	-	-	100K Ω	12V DC@30 mA	Linear
Analog - 0…5V DC	-	30V DC	-	-	100K Ω	12V DC@30 mA	Linear
Analog - 0…10V DC	-	30V DC	-	-	100K Ω	12V DC@30 mA	Linear

Rate Units of Measure: GPM; gal/sec; gal/hr; Mgal/day; LPS; LPM; LPH; ft^3/Sec; ft^3/min; ft^3/hr;m^3/sec;
m^3/min; m^3/hr; acre-ft/sec; acre-ft/min; acre-ft/hr; bbl/sec; bbl/min; bbl/hr; and field programmed custom units 0.00 to 999999999
Total Units: gallons; Mgal; liters; ft^3; m^3; acre-ft; bbl; and field programmed custom units 0.00 to 999999999

Control. Manage. Optimize.

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